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ABSTRACT

This paper describes "Investigative Science in Elementary Education," a project undertaken by the Pennsylvania Department of Education to enable elementary school teachers to make the transition from traditional science instruction to a more modern program. The development of a teacher guide and the methods used to disseminate the materials throughout the state are described. Educational television was a major tool of the dissemination phase with an emphasis on assisting rather than replacing the classroom teacher. The project is presently working toward the development of a system for diagnosing elementary school science instructional problems and prescribing corresponding resources to overcome them. Appendices include (1) an exploration of television program strategies, (2) a sample lesson for teaching measurement, and (3) a listing of videotaped resources for the project. (Author/STS)

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INTRODUCING CONTEMPORARY SCIENCE INSTRUCTION INTO ELEMENTARY SCHOOL CLASSROOMS: A STRATEGY FOR CHANGE

A Presentation at the 1978 Convention

of the

National Science Teachers Association

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April 7 - 11, 1978

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

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IR006146

INTRODUCING CONTEMPORARY SCIENCE INSTRUCTION INTO ELEMENTARY SCHOOL CLASSROOMS: A STRATEGY FOR CHANGE

Introduction

There was a time when teaching elementary school was a pretty routine job. Children were taught reading, writing, and arithmetic and had occasional contacts with social studies and science. And then in the late 1950s, something happened to alter all that and pressure grew to make radical changes in the instructional system. Suddenly, the elementary school teacher was deluged by an overwhelming proliferation of new curricula — the new reading, the new social studies, the new music, the new art, the new math, the new science — everything was new.

It became difficult — if not impossible — to deal with all of these at one time. It often became necessary to escape the deluge and retreat to the familiar and workable formulas of the past. Even to venture forth occasionally to explore only one new curriculum area often led to an encounter with a myriad of directions and choices which needed to be considered.

For example, for the teacher who had little or no background in science and was not prepared to deal with these new, sophisticated approaches, it was difficult to know where to begin. It became obvious that many teachers needed some kind of support — some way to gain an introduction to the new science programs if they were to gain any hope of adopting the new approaches to contemporary science instruction.

Investigative Science in Elementary Education

In 1968, the Pennsylvania Department of Education science supervision staff began to recognize this problem and initiated steps to see how it might be overcome. Gathering together a group of individuals from throughout the State who had an interest and expertise in elementary school science, methods were sought by which elementary school teachers could be provided with assistance in their science instruction. The group recognized that there would be no use in trying to compete with the existing national programs. Resources just were not available to even attempt this. What was needed, they decided, was a means by which teachers could make the transition from traditional science instruction, or no instruction at all, to a modern program of instruction. A way was needed to give teachers a handle for grasping contemporary science instructional concepts.

From this committee grew the idea of SCIENCE FOR THE SEVENTIES — a statewide thrust designed to assist teachers in learning some of the basic aims, concepts, and procedures of the new science programs. The name of this project has since been changed to INVESTIGATIVE SCIENCE IN ELEMENTARY EDUCATION (ISEE). In addition to the ISEE Guide which presented this basic background, sample lessons were developed that were designed to provide teachers with experiences in inquiry, discovery oriented teaching. The intention was that, through the use of these materials, a teacher could, in her own classroom, begin to explore some of the new science instructional techniques and become prepared for attempting some of the newly developed programs which were available.

The committee worked diligently and soon accumulated a wealth of valuable materials which, as they were produced, began to accumulate in impressive numbers on the shelves of the science office at the State Department of Education. It soon became obvious that, in spite of the potential value of these materials, they would serve no use unless they could be placed in the hands of elementary school teachers throughout the State. But, how was this to be accomplished? How might teachers be given any hope of acquiring these materials that were designed for their use. After all, Pennsylvania is a large state, with thousands of schools, and tens of thousands of teachers.

Dissemination of Investigative Science in Elementary Education

The ISEE committee wrestled with this problem. After much discussion, it was decided to explore all available communications media, technological resources, and school administrative channels that might possibly be used to accomplish this task of dissemination. Considered were: newspapers, telephone, educational and commercial radio, educational and commercial television, computer assisted instruction, community cable systems, journals, and other publications, school intermediate units, educational broadcast councils, and a variety of other potential vehicles for change.

The Use of Instructional Television

One of the first of these to be explored in depth was the use of statewide educational television. This, it appeared, might be a way to reach every elementary school classroom in a short period of time. However, some shortcomings were evident. The major one of these was that the passive nature of television viewing and the active nature of elementary school science just didn't seem to go together. It soon became evident that traditional television instruction and contemporary elementary school science instruction are totally incompatible. In other words, you just can't teach elementary school science by television.

However, it was determined that there were two potential uses of television in instruction. One of these was the communication impact of the medium — the fact that it can reach a large audience in a short period of time. The other was the possibility that it could be used to assist teachers and students over any possible obstacles in their transition into the scientific exploration involved in Investigative Science in Elementary Education.

With this notion in mind, the various ISEE lessons were carefully tested in a number of classrooms by elementary school teachers. These teachers and other observers noted ways in which either the teacher or the students might use assistance in preparing for, and more effectively pursuing, the ISEE lesson. From this, scripts were prepared and television programs produced to serve as a transition into the science activities to follow.

When the children seemed to need some help in conducting a particular procedure, it would be modeled on the television screen. When the children had difficulty with a particular technique, an effort was made to demonstrate

it in advance. When the lesson called for assembling a piece of apparatus, the television program was designed to show how it was done.

In addition to the ISEE-ITV programs which were designed for use in the elementary school science classroom, a number of programs were produced to orient teachers to ISEE, assist them in using the ISEE-ITV programs, and provide them with additional insights into employing the ISEE teaching strategies. Even a televised test of science processes was prepared for widespread use throughout the State. A complete list of ISEE-ITV resources is provided in Appendix C.

ISEE Teaching Strategies

Of perhaps more importance, however, were the needs of the teacher who may not have ever taught science lessons of this type before. These teachers discovered that special techniques were required to stimulate inquiry and process-oriented investigations among their students. To assist them with these special teaching methods, the ISEE Committee identified six instructional strategies which teachers could use to improve the effectiveness of their science teaching. Each one of these strategies was designated by a representative symbol. (Appendix A)

The television programs were then prepared to include periods of time for discussion between the teacher and students about some question or information presented on the screen. During these discussion periods, teachers are encouraged to practice the use of these strategies during their interaction with the children.

Teacher's ISEE-ITV Handbook

A handbook is provided to give the teacher necessary assistance in working with her class. An introduction of the lesson provides necessary background information and preparation activities (Appendix B, p. 1). During the lesson, the teacher can refer to a chart of discussion periods which tells her the length of the discussion period, what is to be discussed, something that she can say if she wishes, and, most important, suggests an appropriate strategy to practice with her class during this period of time (Appendix B, p. 2). Also included in the handbook is the ISEE lesson that the class will engage in following the televised introduction (Appendix B, pp. 3-4).

So, when the ISEE television program comes on the air, the classroom teacher is prepared for its use, conducts activities and discussions at the appropriate times, and proceeds confidently to teach the ISEE lesson having had an orientation through television and guidance in the appropriate instructional strategies in her handbook.

Other ISEE Implementation Procedures

While the ISEE-ITV programs and related materials were being produced, numerous other ISEE resources and implementation procedures were under development. The following activities will provide a sample of some of the important elements of the total ISEE dissemination and implementation system.

1. The Pennsylvania Department of Education offered a service through which schools, colleges, or school districts desiring copies of the ISEE-ITV programs could submit blank video tapes and have copies of the television programs dubbed free of charge.

2. Instructional Materials Centers located at the 29 School Intermediate Units within the State began to acquire copies of the ISEE-ITV programs for distribution to schools in their service areas.

3. A cadre of over 400 ISEE representatives from throughout the State were oriented to ISEE and the ISEE resources so that they could serve as information resources and consultants in their regions of the State.

4. A variety of formats for ISEE workshops, inservice credit courses, and university credit courses were developed. These utilized formats including self-instructional courses, courses offered partially through cable or broadcast television, and courses presented in a traditional format. These courses have been piloted, revised, and presented throughout Pennsylvania.

5. Procedures have been developed and implemented to encourage parent and child participation through combining newspaper columns and evening ISEE-ITV broadcasts.

6. Procedures have been developed for establishing long-distance telephone contact between elementary school teachers in a school district using ISEE and members of the ISEE development team.

7. Extensive distribution and utilization of ISEE resources has been carried out by the seven ITV broadcast councils that serve the schools of Pennsylvania.

8. A study has been initiated to determine means for more effectively distributing the ISEE-ITV resources through television cable facilities throughout the State.

The Future of ISEE Implementation Procedures

All of these resources for the improvement of elementary school science can be utilized most effectively if they are in some way coordinated in a manner which will draw upon that combination of people, materials, agencies, and communications channels which can be used to overcome instructional problems that exist in a school district, school or individual classroom.

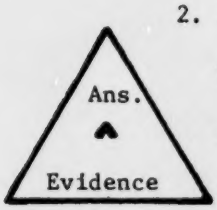
To this end, the ISEE project is presently working toward the design and development of a system for diagnosing elementary school science instructional problems and prescribing corresponding ISEE resources which will assist in overcoming those problems. With such a system, any school district in Pennsylvania could perform a self-assessment diagnosis of their elementary science program and, from it, have produced a prescription for the appropriate ISEE resources that can be used for program improvement.

Once this coordinated diagnosis/prescription system is developed and operational in Pennsylvania (present estimates are that this will be achieved by 1979), every effort will be made to adapt it for use in other states and regions of the United States. The desired outcome is to provide a system by which any teacher, school, or school district can determine what is needed to promote more effective inquiry oriented science instruction for elementary school students and initiate a coordinated effort to bring it about.

STRATEGIES: an explanation -

Each televised program utilizes one or more of these strategies. When they occur, they are identified in the TV lesson guide sheet by a key symbol (in the Teacher's Guide to student-teacher-TV interaction).

1. Teacher questions require students to arrive at an answer by examining and manipulating the materials they are using.

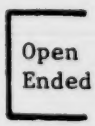


2. Responses are accepted when students use evidence from their lesson activities in observing and responding.

3. Student interpretations are considered acceptable, (even though they are partial or temporary conclusions), as long as the evidence from their investigations and experience supports their responses.

4. Reasonable time is provided during discussion for observation, thought and reflection.

5. Teacher questions and behaviors emphasize the use of the SFTS processes including observing, classifying, communicating, measuring, inferring, predicting and experimenting.



6. Teacher questions encourage wider student thought and suggestions for additional investigative behavior.

APPENDIX B

INVESTIGATING MEASUREMENT

Television Introduction

Teacher Orientation

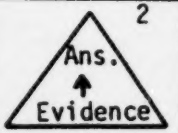
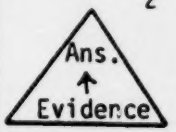
This introduction is designed to provide a transition into the "science activities" which you will conduct following it. You will probably want to spread the SFTS lesson activities over several days. Emphasis in this television presentation will be placed upon introducing basic concepts and techniques leading to student instructional objectives as well as techniques that you may use to promote these desired objectives.

The television presentation opens with scenes that illustrate size discrepancies - things that are too large and too small. From that point, attention is given to ways in which the appropriate size can be determined. Where discrepancies are large, they can be determined through direct examination. But, when size differences are very slight, they must be determined and compared through more careful measurement.

The program was televised in an urban environment and is centered around the measurement required for a group of children to complete a go-cart as well as the purchase of a pair of shoes for one of the girls.

The final scene of the televised program requires that the teacher be prepared with five strips of construction paper or cardboard 12 inches by 1 inch. If each of the pieces of paper was a different color, this would be helpful. The teacher should be prepared to place each strip of paper against the TV screen and cut to a prescribed length.

The science and mathematics concepts for which this SFTS lesson serves as a readiness experience are: large, small, and length. On five occasions during the television introduction, questions are posed and time provided for discussion in the classroom. The charts on the next page indicate the length of discussion periods, questions raised and suggested strategies which may be followed:

Discussion Period and Time	TV Image	SETS/ITV: INVESTIGATING MEASUREMENT (black & white)		Teaching Strategy
		Final Broadcast Statement	Suggested Statements or Questions	
1 (no break given)	Mother and daughter leaving house	In each case what do you think the problem is?	What did you see in the pictures that the people were having trouble with?...What else did you see happening?	2 
2 30 sec.	Girl's feet and three groups of shoes	...and which are about right?	Pick out the large ones...and the small ones...and the ones that are the right size.	1
3 20 sec.	Girl's foot next to two shoes	Without trying them on. Can you think of any way you can check to see if they fit?	Can you think of any way of telling which shoes might fit this foot?...What else might you do to find out?	6
4 Extended discussion period	Scenes of measurement	Watch closely and tell about what kind of measuring you see being done.	What do you think she (he) is measuring for?	2 
5 1 min.	Five strips of wood	Take a minute to find the longest and the shortest.	NOTE: The teacher should cut strips of paper the lengths of the shoes on the screen. Number the strips to correspond with the shoes. Ask students to arrange strips from shortest to longest.	5 Measurement

Title: Investigating Measurement (Dr. Roy Allison) An SFTS Representative Experience

Level: Primary

Aims: From SFTS Toward Which This Lesson Contributes

1. The student will measure the length of objects.
2. The student will solve problems by gathering information, working independently--using equipment and materials, observing purposefully and drawing appropriate conclusions based on these findings.
3. The student will demonstrate a competency in the use of the processes of science by: (a) observing, (b) communicating, (c) measuring, (d) inferring.

Instructional Objectives: At the conclusion of this lesson, the students will be able to:

1. determine when two objects are the same length,
2. determine which objects are longer than or shorter than the other objects they have measured,
3. order themselves from tallest to shortest.

Background Information:

This lesson is intended as an introduction lesson to the process of measurement. The students will begin with direct measurement by comparing the lengths, heights, or widths of objects with other objects. They will move to indirect measure by employing a third object to obtain some knowledge of the lengths, widths or heights of the two objects they are to compare.

Total Equipment List:

1. A cardboard box (A) just slightly too large to fit under a table in the classroom.
2. A classroom table.
3. A pointer, window pole or object longer than the cardboard box is tall.
4. A group of objects of assorted lengths which could be put in order by lengths.
5. A cardboard box (B) that just barely fits under a table in the classroom.

Activities: Each activity will take about 15 minutes

Activity I - Readiness Survey

Materials needed: the pupils

The teacher should name two pupils who are of slightly, but obviously, different heights and ask the class who is taller. Continue to add class members to the group at the front of the room and have the remainder of the class place them in order from shortest to tallest. When the class is in doubt, have the child to be placed stand back to back with as many pupils as necessary to allow the class to compare the child's height with that of the child's classmates.

The comparison of one concrete object with another is a basic or beginning step in measurement. The teacher may wish to repeat this exercise with other materials until the class becomes proficient in ordering objects.

Activity II

Materials needed:

1. A cardboard box (A) just slightly too large to fit under a table in the classroom.

2. A classroom table.

3. A pointer, window pole or other object longer than the box is tall.

The teacher should have the cardboard box placed so that direct comparison with the table height could not be made. Ask the class if the box will fit under the table and explain that you don't want to transport the box unless it will fit under the table. Permit or encourage the use of a pointer, window pole or other long objects in an indirect comparison of the height of the box and the table. Some students may stand beside the box and mark on their body where the box touches, then walk to the table to see if the table is higher than this mark.

Questions like "Is the box as high as Joe's shoulder?" "Can Henry stand up under the table?" may help lead the class to the discovery of indirect methods of measurement.

Repeated work with objects that will and will not fit together will promote understanding.

Competencies:

Give each student a group of objects of assorted lengths, and have the students order them from shortest to longest.

Trade box B for box A during pupils' absence and ask each student to determine if the box will fit under the table as before.

Appendix C

ISEE INSTRUCTIONAL TELEVISION RESOURCES

In order to assist children and teachers in elementary school classrooms to more effectively utilize the SFTS guide and puruse the SFTS science lessons, a number of television video tapes were produced.

Primary Level SFTS-ITV Programs

A series of ten television video tapes is available for use in primary grade classrooms. Each television program is designed to introduce a class to an SFTS science lesson. The programs are structured to be interactive. As a part of each program, opportunities are provided for teachers and students to discuss questions or pictorial displays provided on the television screen. During these discussion periods, teachers are assisted in employing instructional strategies which stimulate more effective inquiry on the part of their students.

Instructional television programs (15 minutes each) are available which relate to the following primary level lessons:

Investigating Drops
Investigating Mystery Boxes
Investigating Observation & Description
Investigating Measurement
Investigating the Thermometer
Investigating Eyes
Investigating Salt and Water
Investigating Siphons
Investigating Dripping Faucets
Investigating Reflection of Light Beams

Intermediate Level SFTS-ITV Programs

A series of ten television video tapes is available for use in intermediate grade classrooms. Each program is structured in a manner similar to the primary level programs in that it provides for active teacher-student interaction and assists in introducing a class to an SFTS science lesson.

Instructional television programs (20 minutes each) are available which relate to the following intermediate level lessons:

Investigating Floating Things
Investigating Ice and Water
Investigating Things that Magnify
Investigating Friction
Investigating Heat Loss
Investigating Bouncing Objects

Investigating Strips and Liquids
Investigating Sound
Investigating Evaporation
Investigating Problems of Sprouting Seeds

Teacher Orientation and Instructional Programs

Seven special half-hour television programs have been developed to familiarize teachers with the SFTS-ITV resources and assist teachers in the use of appropriate instructional strategies for facilitating student inquiry. The following are the titles and brief descriptions of these programs:

An Introduction. An Introduction provides an overview of SFTS and the SFTS-ITV programs with special attention given to the role of the classroom teacher in utilizing SFTS resources. The major focus of this program is at the primary grade level.

The Development. The Development is designed to provide primary level teachers with additional insights into SFTS by illustrating how the SFTS-ITV programs were developed to assist them in their science instruction. Examples of primary level science lessons and ITV programs are incorporated into this program.

An Orientation. An Orientation has been prepared to orient intermediate grade teachers to the SFTS and SFTS-ITV resources.

SFTS Teaching Strategies I. The SFTS and SFTS-ITV materials are designed in such as way as to encourage teachers to employ instructional strategies which facilitate scientific inquiry on the part of students. This program describes and illustrates six instructional strategies that are an integral part of the SFTS thrust.

SFTS Teaching Strategies II. This program provides a followup to SFTS Teaching Strategies I. In the context of a demonstration lesson, the viewer is shown how the six SFTS instructional strategies are used. Opportunities are provided for the viewer to analyze the demonstration teacher's approach to the lesson and identify what strategies are being used.

Strategies in Action. In the context of a demonstration lesson, an in-depth analysis is provided of the instructional strategies being used by the demonstration teacher.

Diagnosing Decisions in Classroom Teaching. A specialist in elementary school science instruction provides insights into instructional decision making by critically analyzing his own teaching of an SFTS lesson.

A Television Test of Science Processes

This test, in two, thirty-minute segments, is designed for use in measuring student science process skills at about the fifth grade level. In addition to the television segments, test booklets and instructions for teachers are also available.